Using MODIS AQUA Collection 5 data to Constrain GISS ModelE Aerosol Climatology - Preliminary Results

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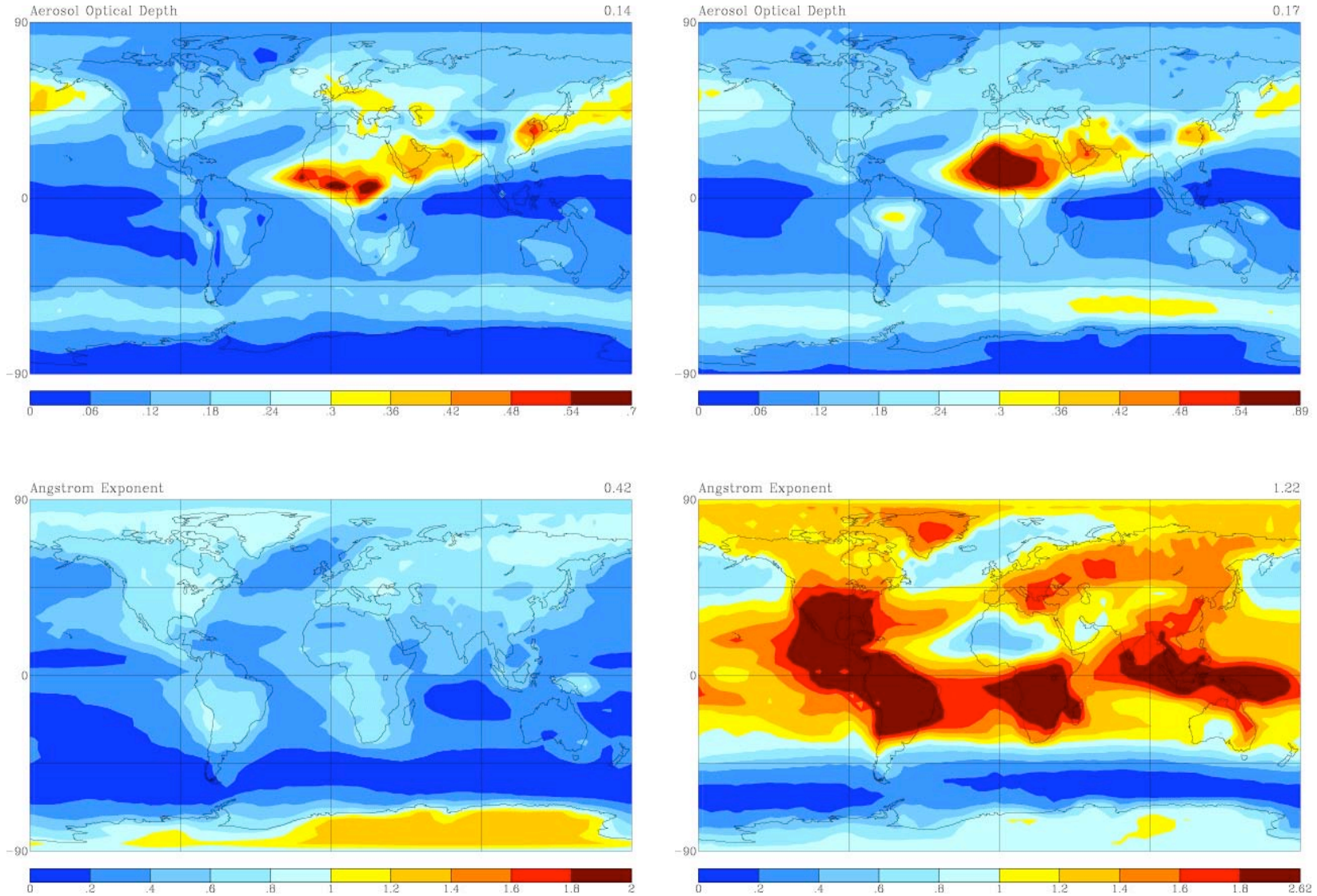

Figure 1. Global annual mean total aerosol optical depth and Angstrom exponent from GISS ModelE [Schmidt et al., 2006] (left column) and Koch [2006, private communication] (right column). Numbers at top right corner represent the area weighted global means with missing data skipped. The color bars are evenly scaled, except the right end numbers, which represent the maximum value for each panel.

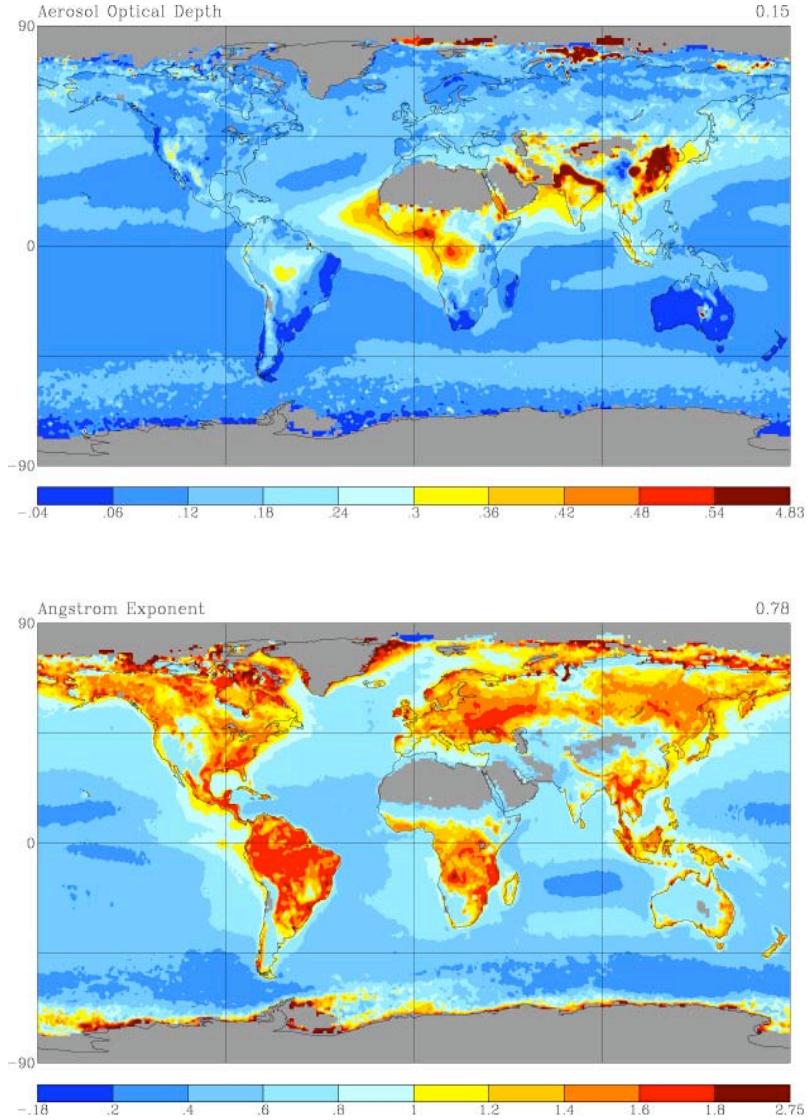

Figure 2. Global distributions of MODIS AQUA Collection 5 Level 3 Quality Assured monthly averaged aerosol optical depth and Angstrom exponent.

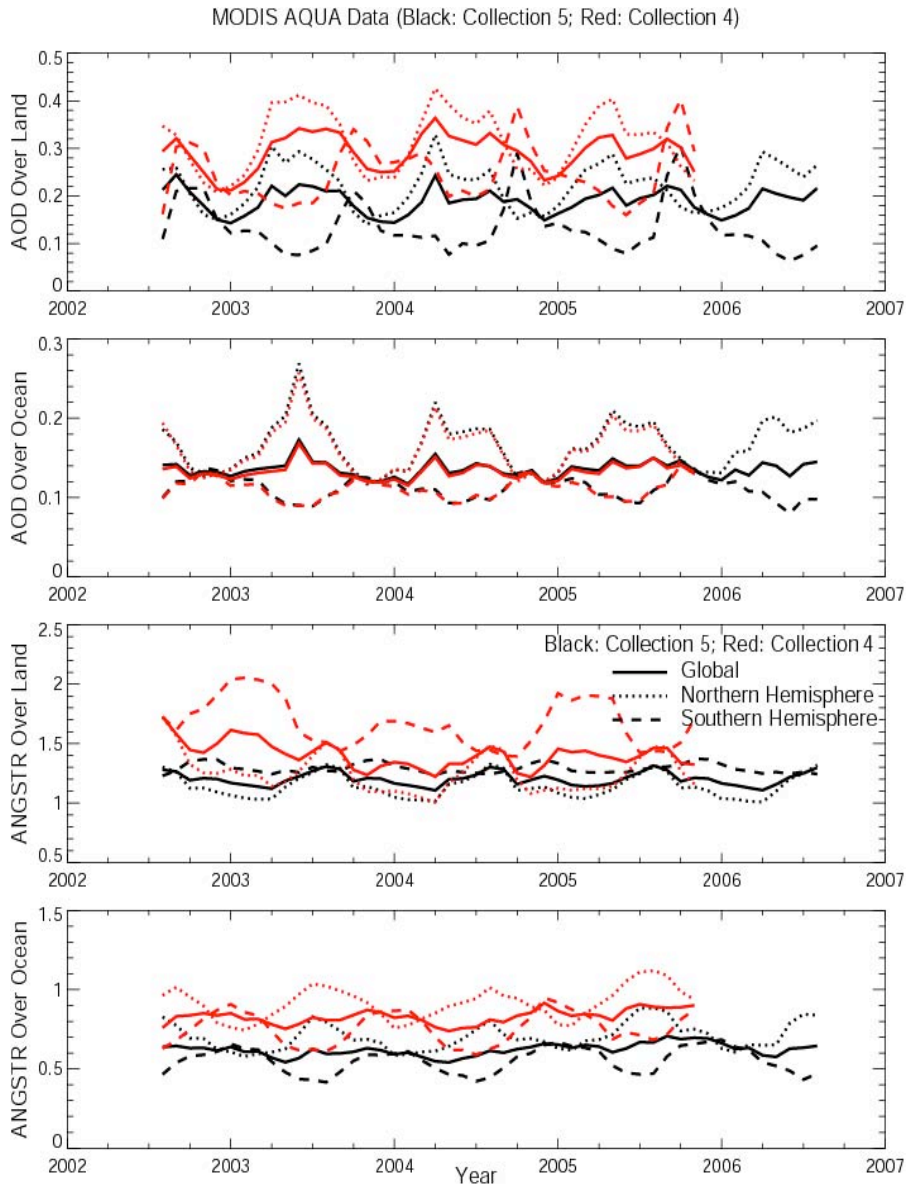

Figure 3. Time series of the global mean values of the aerosol optical depth (top two panels) and Angstrom exponent (bottom two panels) for MODIS AQUA Collection 5 (black curves) and Collection 4(red curves) data.

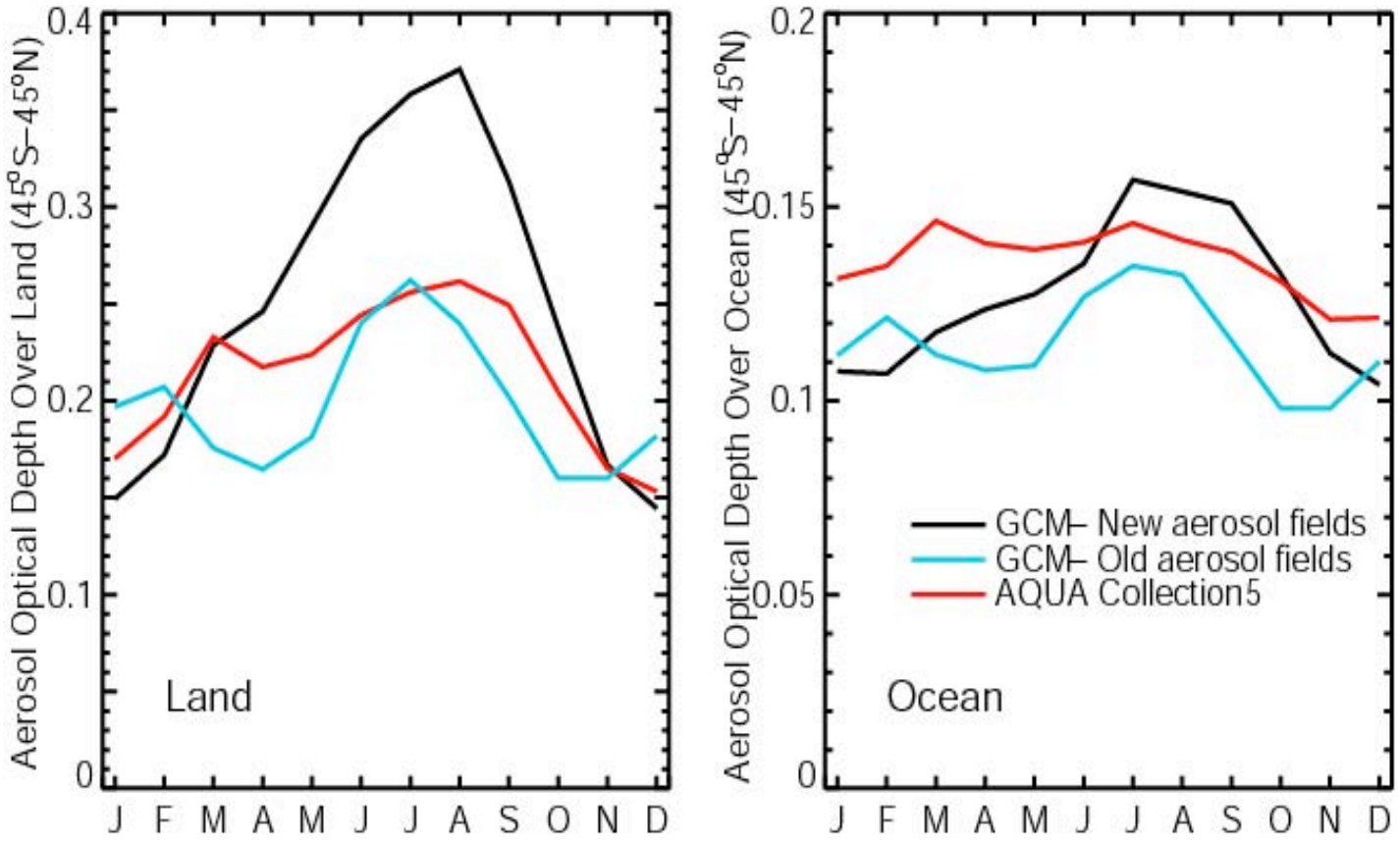

Figure 4. Seasonal dependence of area weighted overall monthly mean aerosol optical depth from different data sources. Data over land (left panel) and over ocean (right panel) have been constrained between the 45 degree south and north latitudinal band.

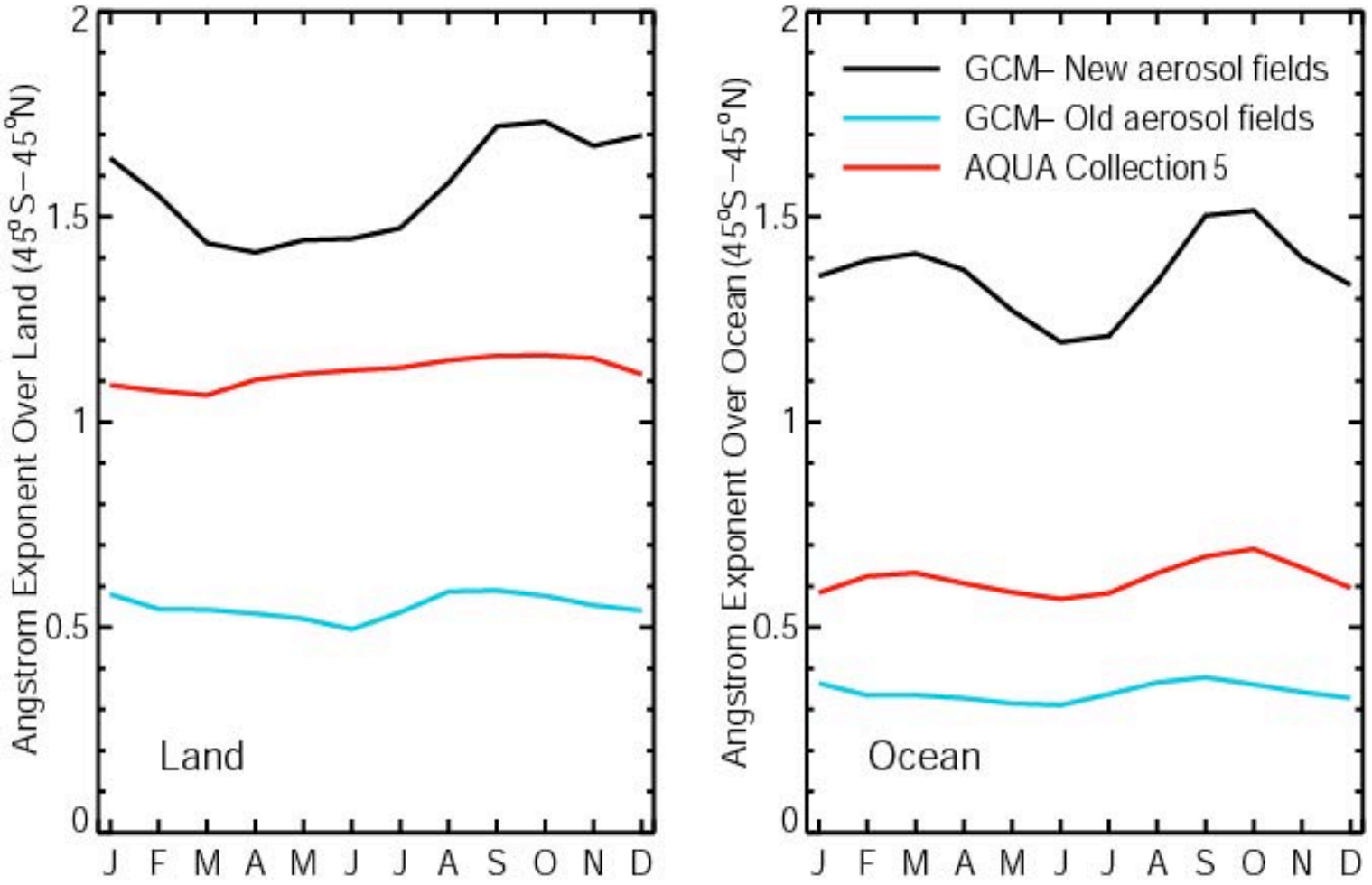

Figure 5. Same as Fig. 4, but the averaged data are for the Angstrom exponent.

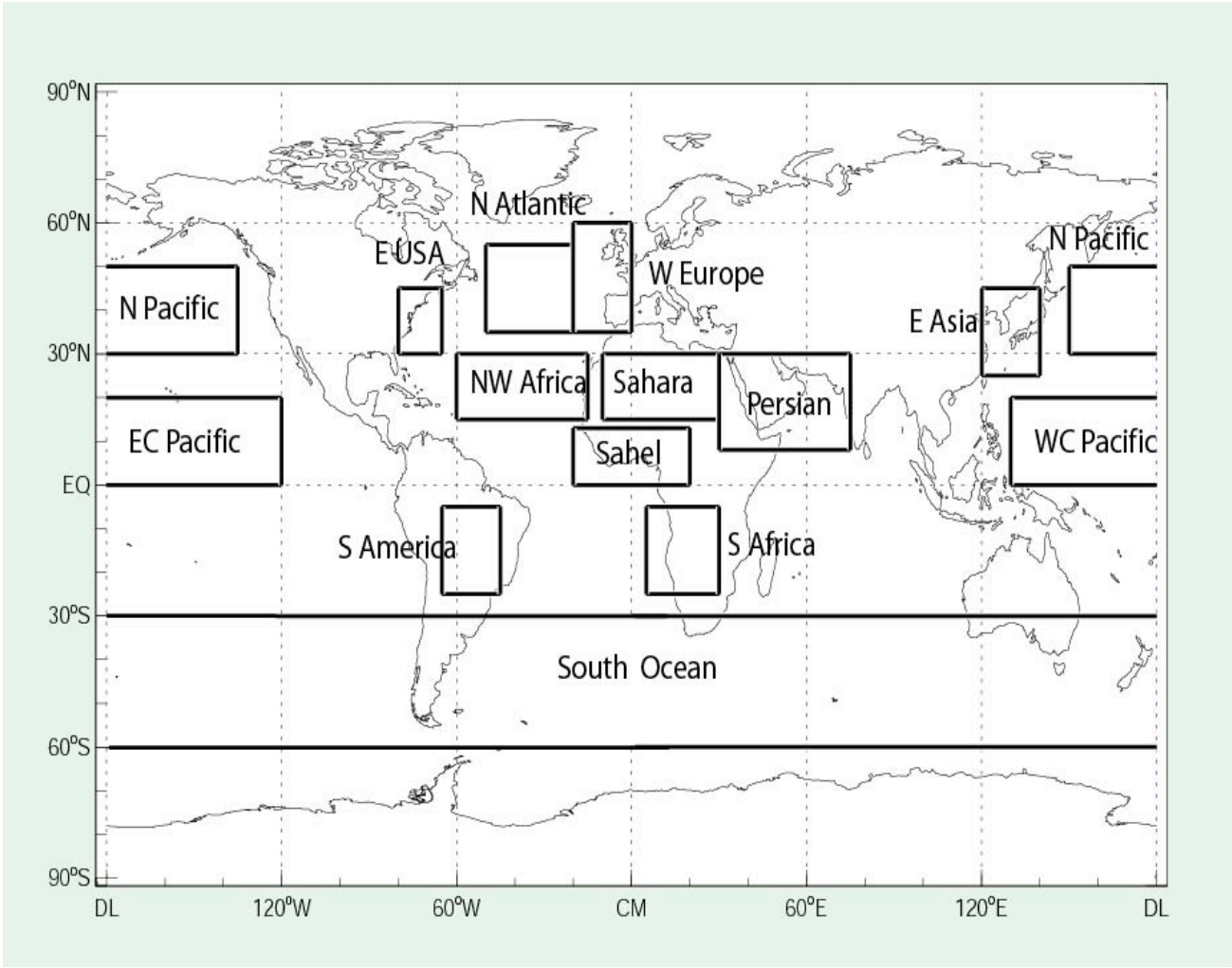

Figure 6. Regions selected for comparison of GISS GCM aerosol climatology with MODIS AQUA Collection 5 data.

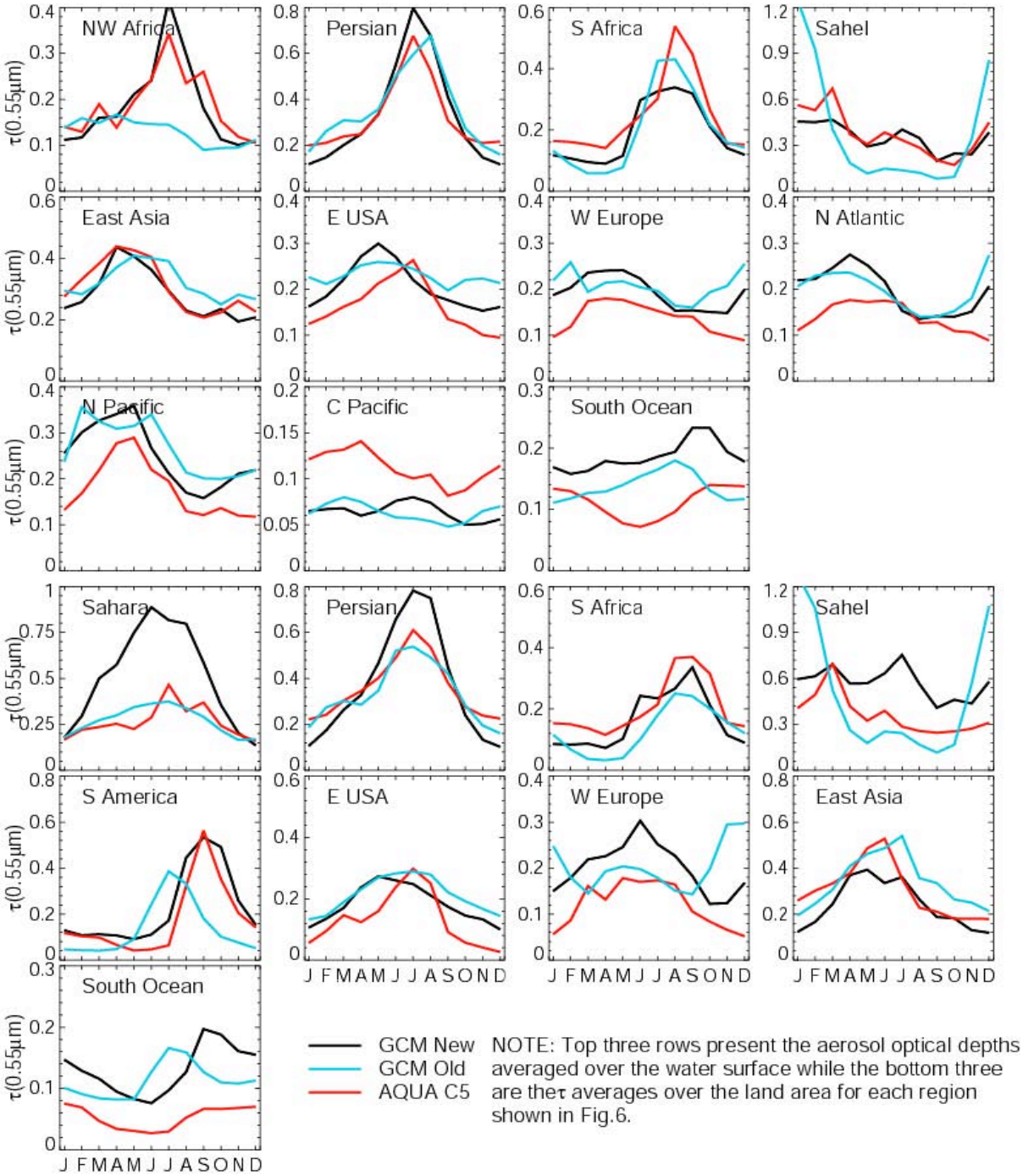

Figure 7. Regional analysis of overall monthly mean aerosol optical depth averaged over the various aerosol regimes shown in Fig.6. Averages are computed over water surfaces (top three rows) and land areas (bottom three rows) if the designated area contains both land and water masses.

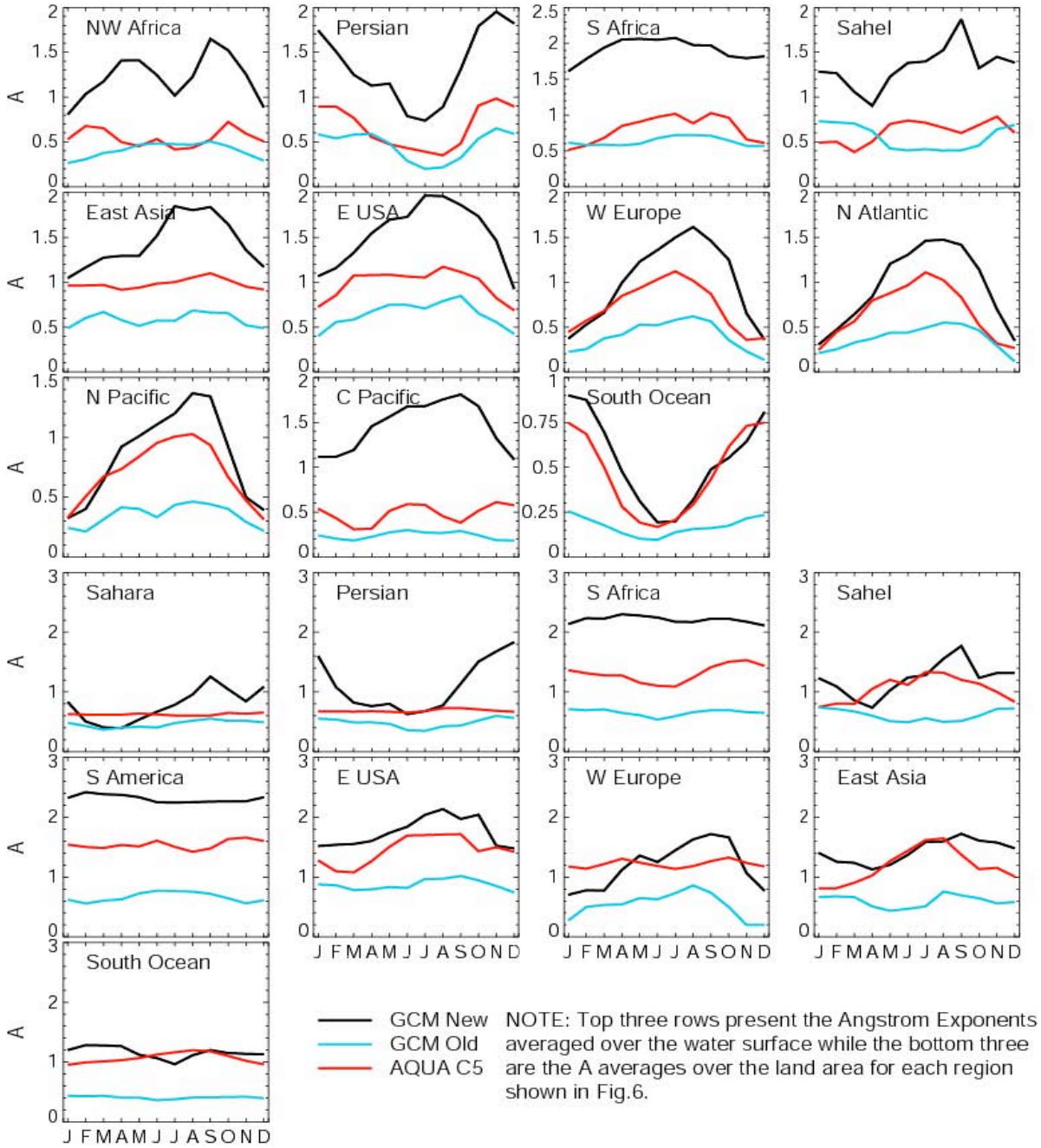

Figure 8. As in Fig. 7, but for seasonal dependence of overall monthly mean Angstrom exponent at different places shown in Fig.6.

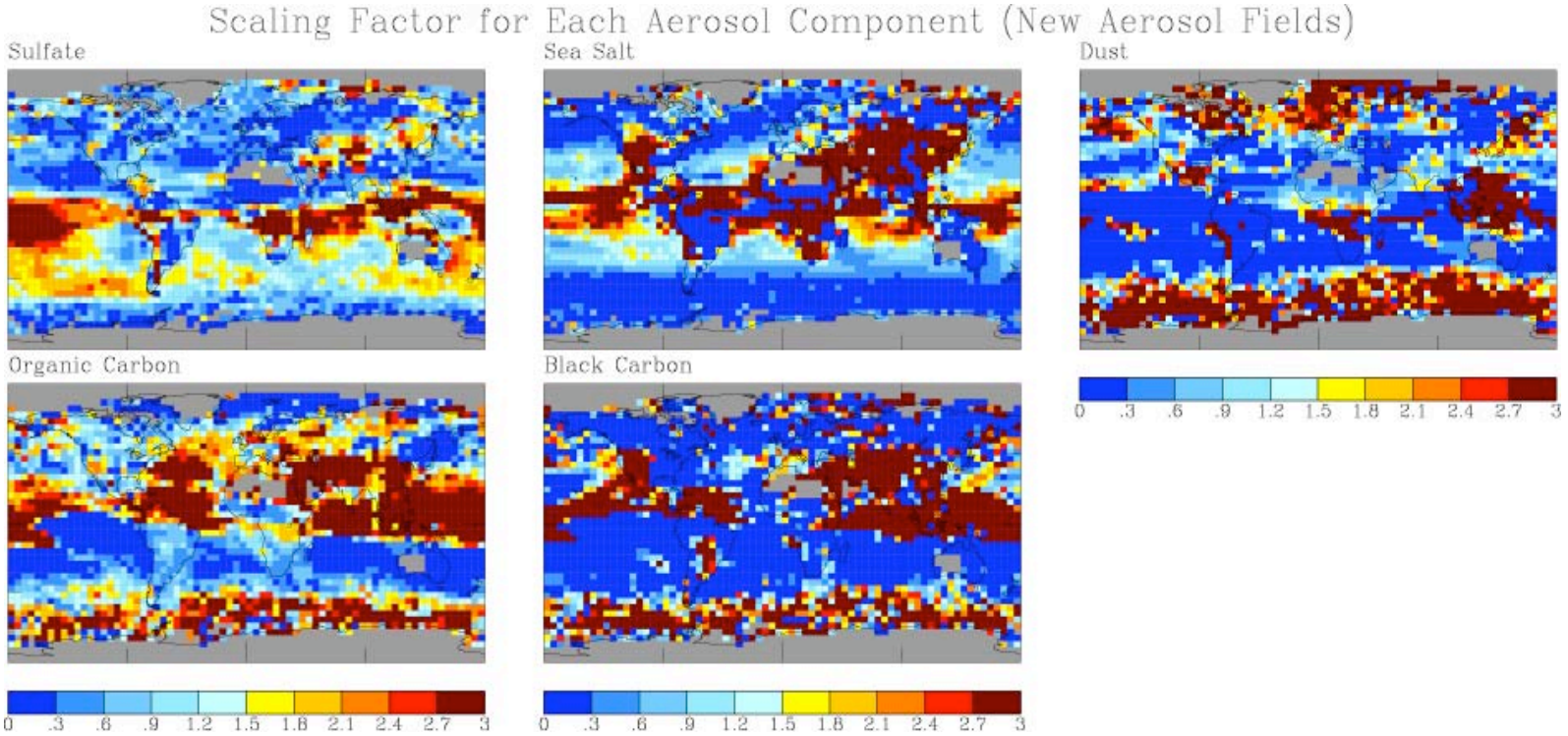

Figure 9. Scaling factor for each aerosol component to minimize the differences in annual mean aerosol optical depth between the GCM new fields [Koch, 2006] and MODIS AQUA Collection 5 Level 3 monthly averaged data.

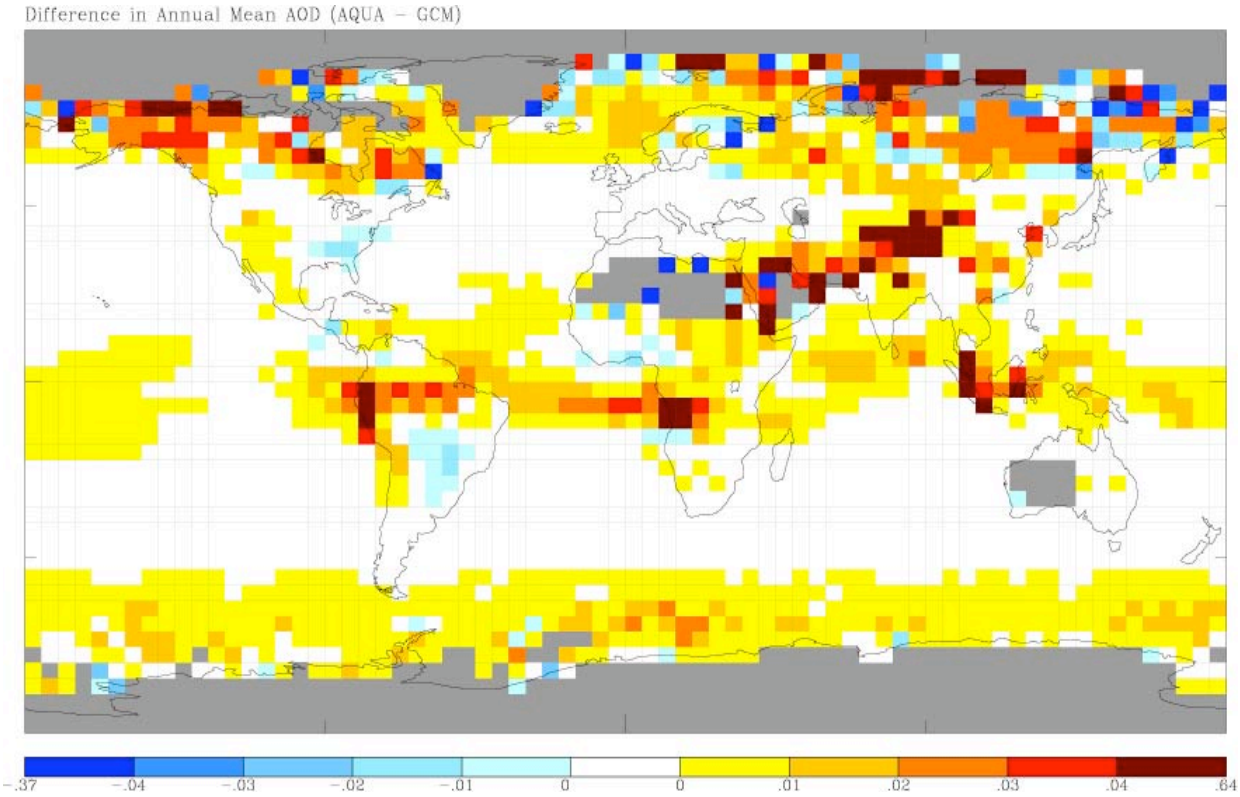

Figure 10. Differences in annual mean aerosol optical depth between MODIS AQUA Collection 5 data and the fitted GCM aerosol distribution. The global area weighted mean is 0.0056.

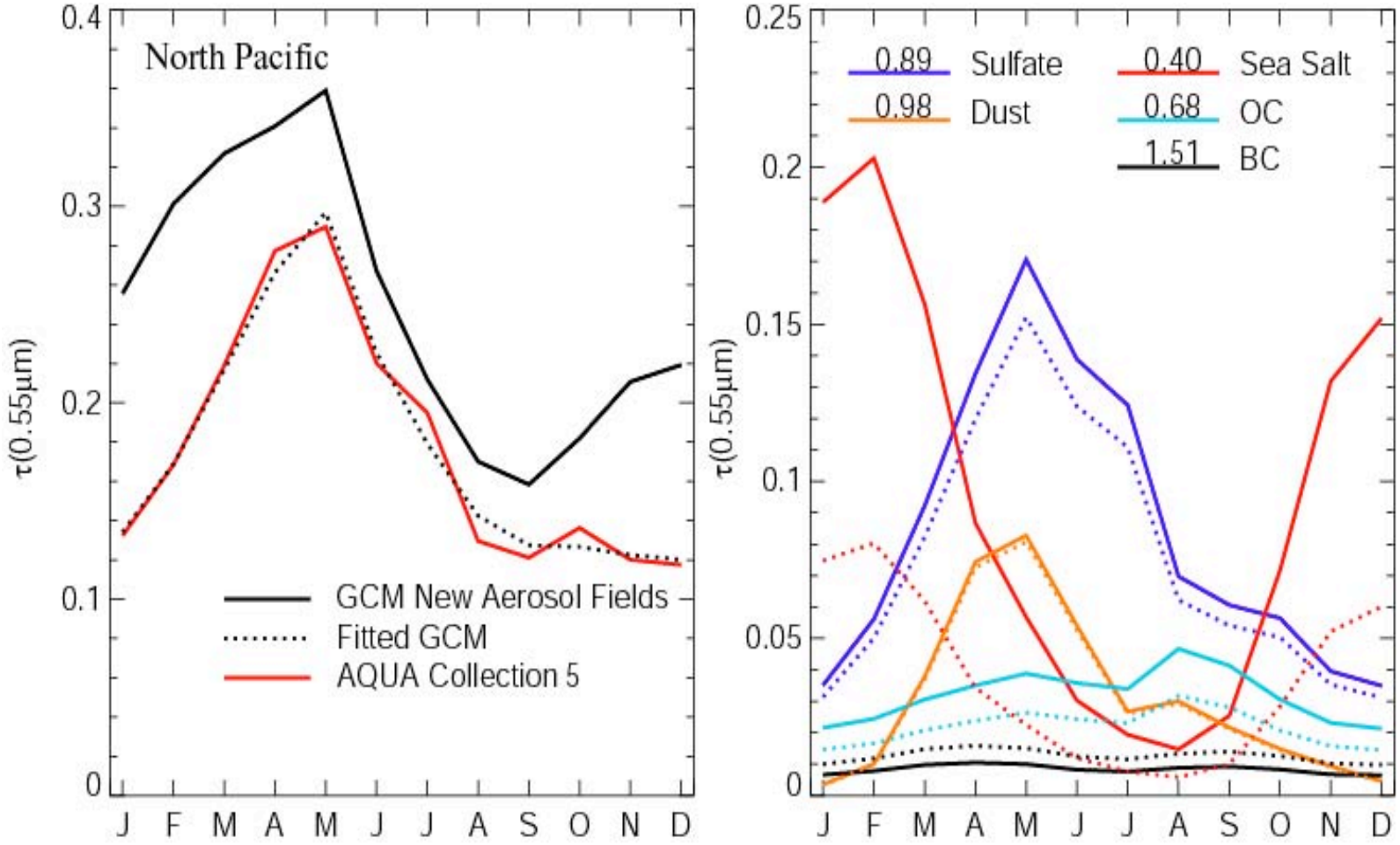

Figure 11. Seasonal dependence of overall monthly mean aerosol optical depth (left panel) and the relative contributions of each principle aerosol component considered in the GCM [Koch, 2006] to the total AOD (right panel) over North Pacific shown in Fig.6. The dotted curves present the relative contributions (times the scaling factors) of each principle aerosol species to the fitted GCM aerosol.

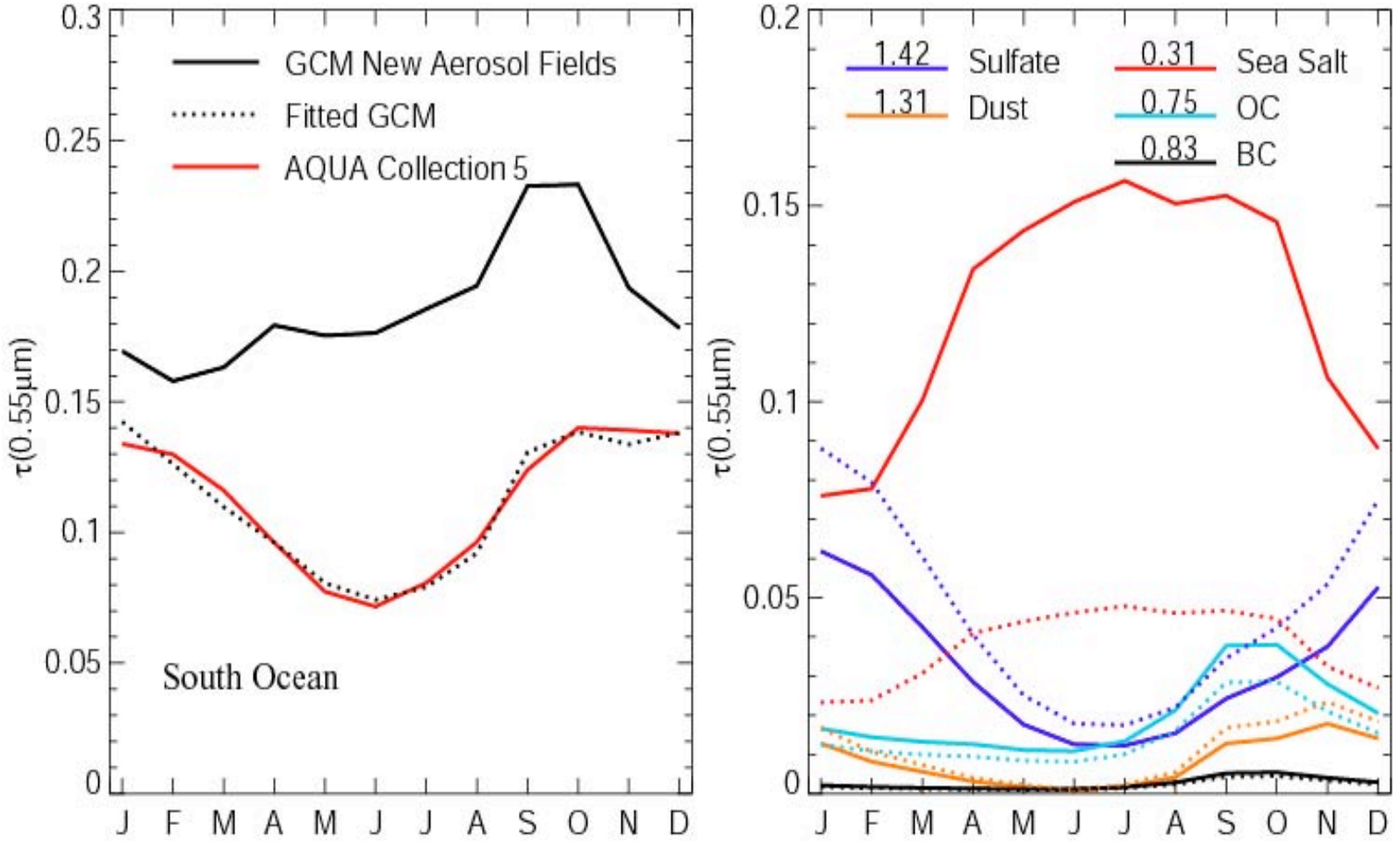

Figure 12. Same as in Fig. 11, but for aerosol optical depth over South Ocean shown in Fig.6.

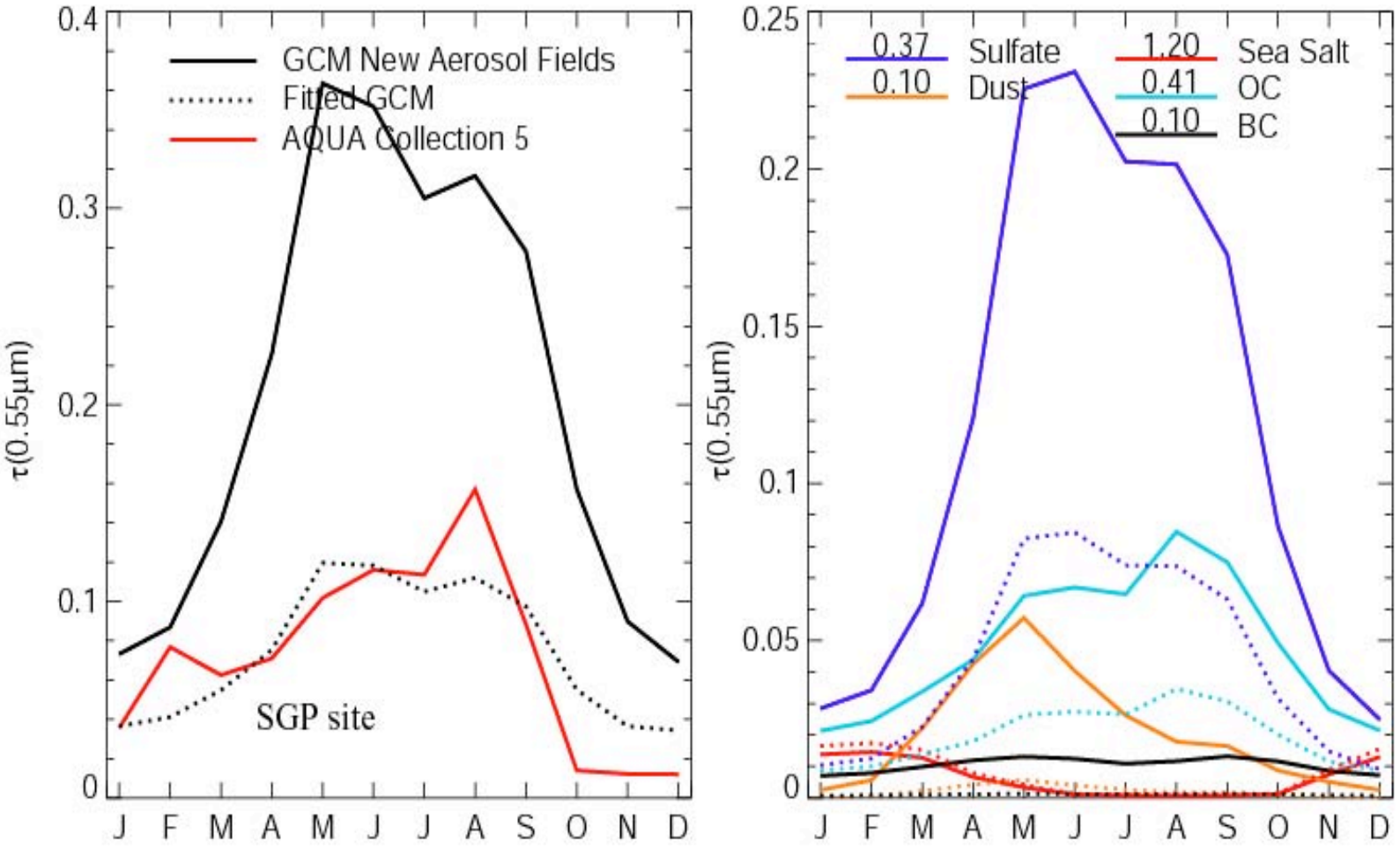

Figure 13. As in Figs. 11 & 12, but for aerosol optical depth distribution over SGP site.

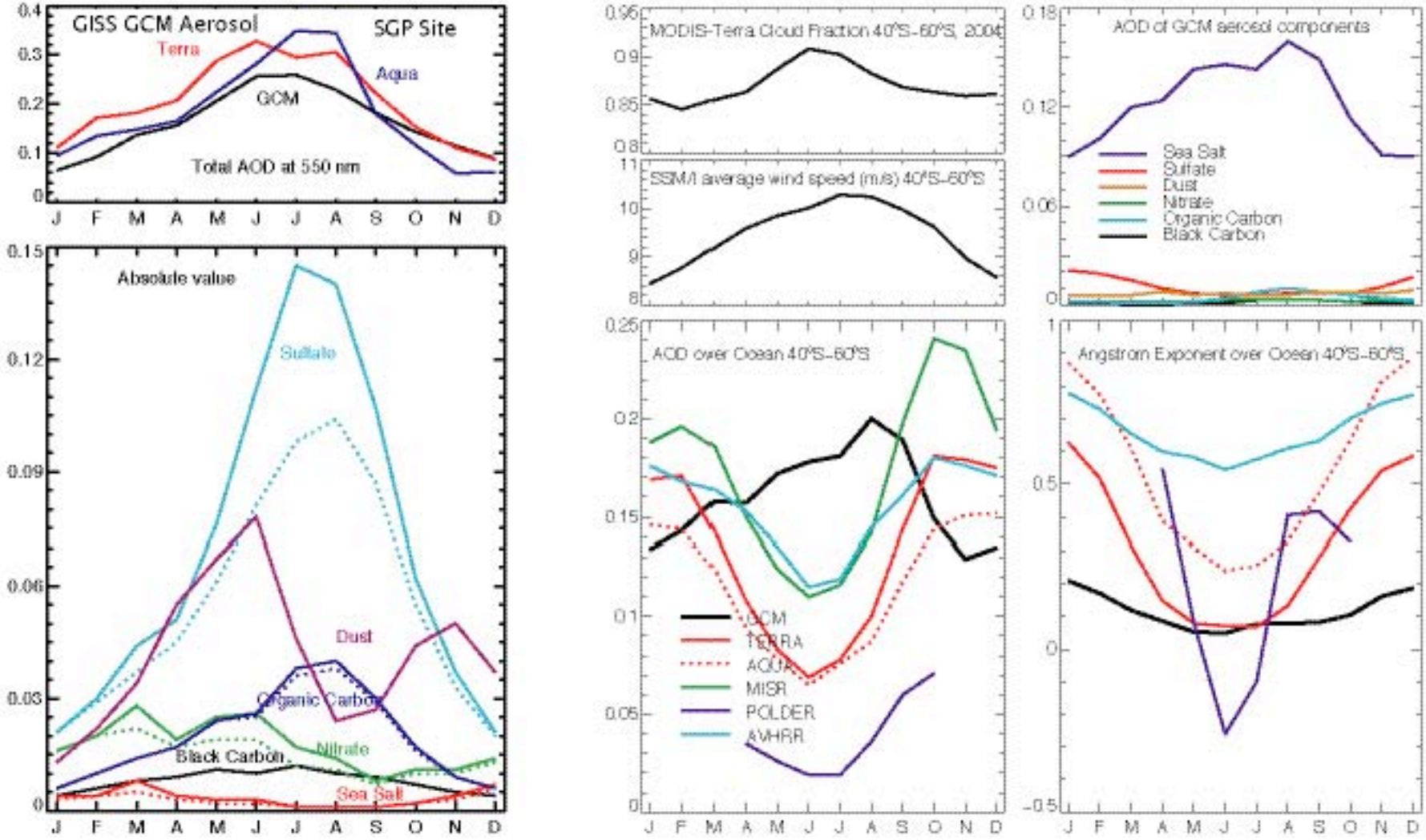

Figure 14. Seasonal dependence of monthly mean aerosol optical depth as SGP and South Ocean using earlier MODIS and ModelE aerosol data. Note AQUA aerosol peak optical depth of τ=0.3 at SGP compared to Collection 5 SGP optical depth τ=0.15, while ModelE peak optical depth τ=0.25 increased to τ=0.3 Koch [2006]. There has also been a significant shift in GCM sea salt seasonality between ModelE and Koch [2006] results in the South Ocean region.

Conclusions

- The GISS ModelE [Schmidt et al., 2006] aerosol optical depth reasonably agree with the newly released MODIS AQUA Collection 5 data, but the Angstrom exponent is clearly biased low, implying that the aerosol size specified in the GCM are overestimated.
- The new aerosol climatology [Koch, 2006] shows some improvement, particularly in terms of the seasonality of aerosol optical depth. But the Angstrom exponent is now too large. Increasing organic carbon size would be appropriate to start with since the bias is greatest in biomass burning regions like South Africa, South America, and Sahel.
- The preliminary results of the improved aerosol optical depth distribution using the newly available MODIS AQUA Collection 5 data as constraints are heartening.